IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	)	Attorney Docket No.: **SUGI0166**
Tadahiro OHMI et al.	)	Confirmation No.: 9535
Serial No.: 10/597,343	)	Group Art Unit: 3753
Filed: July 20, 2006	)	Examiner: William M. McCalister
For: METHOD FOR WATER HAMMERLESS OPENING OF FLUID PASSAGE, AND METHOD FOR SUPPLYING CHEMICAL SOLUTIONS AND DEVICE FOR WATER HAMMERLESS OPENING FOR WHICH THE METHOD IS USED	)	

DECLARATION UNDER 37 C.F.R. § 1.132

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Sir:

1. I, Kouji NISHINO, state that I am one of the co-inventors of the subject matter of the above-captioned U.S. Patent application, and that I am expert in the field of the above-captioned application as evident from the attached copy of my Curriculum Vitae (which is filed herewith labeled as "Exhibit AA").

2. I am familiar with the above captioned application and claims as amended by Amendment (F) filed herewith. Attached herewith, as an Appendix, is a copy of the claims I have considered for this declaration.

3. In this declaration, I submit expert testimony regarding the meaning of the term "water hammer" as it is used in the specification and claims of the above-captioned application, and as it is used by persons of ordinary skill in the art. In rendering my opinion, I have considered the following materials, which I believe an expert in the art would reasonably consider when rending such an opinion: (a) the original specification, drawings and claims of the above-captioned application, (b) the claims as amended by Amendment (F), (c) the webpage titled *WATERHAMMER, A COMPLEX PHENOMENON WITH A SIMPLE SOLUTION, at* www.omega.com, downloaded May 2006, 3 pages, of record (hereafter, the "Omega Document"), (d) Z. Michael Lahlou, *Water Hammer*, National Drinking Water Clearinghouse (2003), 4 pages, of record (hereafter, the "Lahlou Article"), (e) B. Formisano, *Fixing Water Hammer, at* http://homerepair.about.com/od/plumbingrepair/ss/pipe_noises_2.htm, downloaded August 14, 2009, 2 pages, of record (hereafter, the "Formisano Article"), (f) *Water Hammer Calculation. Hydraulic Transient Analysis, at* http://www.lmnoeng.com/WaterHammer/WaterHammer.htm, downloaded August 14, 2009, 9 pages, of record (hereafter, the "LMNOENG Document," (g) Water Hammer, *at* http://dictionary.reference.com/browse/water+hammer, downloaded June 4, 2010, 2 pages, a copy of which is filed herewith as "Exhibit D," and (h) the Office Action mailed February 12, 2010 in the above-captioned application.

Testimony Regarding the Above-Captioned Application

4. I have thoroughly reviewed the originally filed disclosure of the above-captioned application. Paragraph [0002] of the specification of the above-captioned application as originally filed states:

> "It has been widely known that when a passage through which a liquid such as water or the like passes is abruptly closed, there occurs so-called water hammer with which the pressure rises inside the passage on the upstream side of the closed point with vibrations, thus various problems such as the breakdown of devices or instruments connected to the passage being caused by said water hammer. "

The specification of the above-captioned application further describes that the "water hammer" may occur with abrupt opening of a fluid passage as well as with abrupt closing of a fluid passage (Original Specification of above-captioned Application, ¶ [0007]).

5. In view of the above facts, I conclude that the above-captioned application describes the "water hammer" as a phenomenon that occurs with abrupt opening or abrupt closing of a fluid passage that creates vibrations that are substantial enough to cause the breakdown of devices or instruments connected to the fluid passage.

Testimony Regarding the Omega Document

6. I have thoroughly reviewed the Omega Document. The Omega Document, in the first paragraph, states that

> "Waterhammer is an impact load that is the most misunderstood force known to pressure transducers today. A waterhammer is created by stopping and/or starting a liquid flow suddenly. The results of a waterhammer or impulse load are devastating to a pressure sensor. The impulse load occurs suddenly, in the millisecond time frame, but the effects of it last a life time. Waterhammers occur in almost all pressure systems and usually can not be stopped without extensive time, energy and studies."

7. In my opinion, the description of a water hammer, according to the Omega Document, is wholly consistent with how the term is used in the disclosure of the above-captioned application. In particular, a water hammer is a sudden impact load having enough force to damage devices, such as pressure transducers, and that it is a ubiquitous phenomenon found in pressure systems that is difficult to prevent.

Testimony Regarding the Lahlou Article

8. I have thoroughly reviewed the Lahlou Article. In my opinion, the Lahlou Article provides the most precise description of the water hammer. I note that the Lahlou Article is published by the West Virginia University, and that its author purports to have a graduate degree in civil and environmental engineering. In view of the above, and my own knowledge and experience in the art, I believe the Lahlou Article provides the most precise and accurate definition of the term "water hammer" of the materials I have considered for this opinion.

9. According to the Lahlou Article, page 1, left col., lines 2-18,

> "Water hammer (or hydraulic shock) is the momentary increase in pressure, which occurs in a water system when there is a sudden change of direction or velocity of the water. When a rapidly closed valve suddenly stops water flowing in a pipeline, pressure energy is transferred to the valve and pipe wall. Shock waves are set up in the system. Pressure waves travel backward until encountering the next solid obstacle, then forward, then back again. **The pressure wave's velocity is equal to the speed of sound**; therefore it 'bangs' as it travels back and forth, until dissipated by friction losses. Anyone who has lived in an older house is familiar with the 'bang' that resounds through the pipes when a faucet is suddenly closed. This is an effect of water hammer." (emphasis added).

Based on my knowledge and experience in the art, I concur with Dr. Lahlou's definition of a water hammer. In particular, I state that a "water hammer," as that term is used in the art and in the Lahlou Article, pertains to an objective phenomenon that occurs when suddenly

because the velocity of the surge waves in the pipes is less than the speed of sound in the liquid so there is no sonic boom.

12. Based on my knowledge and experience in the art, and as substantiated by the Lahlou Article, both a water hammer and surge may cause substantial damage to pipes, fittings, valves, and other devices connected to a pipeline system; however, only banging is associated with the water hammer. While surge may cause audible sounds in a pipe, it does not cause the characteristic banging associated with the water hammer. Furthermore, while the Lahlou Article specifically identifies two kinds of "transient pressures" (Lahlou Article, page 1, left col., lines 23-25), even less severe transient pressures may occur in a pipeline during opening and closing of the line, which are not associated with any damage to the pipeline system. This last fact is supported by Figures 4(a), 4(b) and 6 of the above-captioned application.

13. More specifically, Figure 4(a) of the above-captioned application shows upstream vibrations caused by a water hammer when a pipeline is opened by opening a valve in one step (See, e.g., specification of the above-captioned application, ¶ [0038]). On the other hand, Figure 4(b) of the above-captioned application shows that vibrations associated with a water hammer may be prevented using a two-step valve opening so that only transient pressure fluctuations that are nearly zero remain. These nearly zero transient pressure fluctuations, such as shown in Figure 4(b), do not rise to the level of a water hammer. This is also the case shown in Figure 6 of the above-captioned application, where a 2-step valve actuating pressure is used to open a valve in two steps and in about 1000 msec without generating a water hammer (See, e.g., specification of the above-captioned application, ¶¶ [0039] and [0040]).

14. Thus, based on my reading of the disclosure of the above-captioned application, I conclude that while the invention prevents the formation of a water hammer (i.e., transient pressures having a velocity of equal to or greater than the speed of sound in the liquid of the pipeline, and that are associated with banging), the invention does not necessarily eliminate all transient pressures, such as those that are too small to cause any damage whatsoever to the pipeline system (i.e., pipes, fittings, valves, other devices connected to the system).

Testimony Regarding the Formisano Article

15. I have thoroughly reviewed the Formisano Article. The Formisano Article discloses that the "water hammer" is a form of hydraulic shock and is associated with the most noise.

Testimony Regarding the LMNOENG Document

16. I have thoroughly reviewed the LMNOENG Document. The LMNOENG Document discloses a mathematical model for simulating the water hammer in a pipeline flowing full, bounded upstream by a large reservoir and bounded downstream by a valve. The fact that there exists a mathematical model for water hammer simulation is evidence, in my opinion, that the water hammer is a physically objective phenomenon, and not a relative or subjective phenomenon.

Testimony Regarding Exhibit D

17. I have thoroughly reviewed Exhibit D, which is a copy of http://dictionary.reference.com/browse/water+hammer, downloaded June 4, 2010. Exhibit D provides several definitions for the term "water hammer" provided by the Dictionary.com

website. The first definition for "water hammer" provided by Exhibit D is "the concussion and accompanying noise that result when a volume of water moving in a pipe suddenly stops or loses momentum." I believe the Examiner relies upon this definition in the Office Action of February 12, 2010, at 9, lines 14-17, and I believe the Examiner's reliance on this definition is inappropriate for the following reasons.

18. First, this definition is based, according to Exhibit D, on the Random House Dictionary. There is no evidence that this source is anything but a general English dictionary, and not a technical dictionary used in the art. Second, based on my knowledge and experience in the art, I know that this first definition of water hammer listed in Exhibit D is too broad as it may include surge and lesser non-damaging transient pressures. In particular, this first definition fails to specify that the "noise" generated is due to the bang caused by velocity of the shock waves equal to, or exceeding, the speed of sound in the pipes. Therefore, as would be instantly understood by persons of ordinary skill in the art, this first definition listed by Exhibit D is imprecise, overly broad, and not in accordance with how the term "water hammer" is generally used in the art as evident from the Omega Document, the Lahlou Article, the Formisano Article, and the LMNOENG Document.

19. Fourthly, and most importantly, I believe that this first definition of "water hammer," listed in Exhibit D, is not consistent with how this term is used in the specification and claims of the above-captioned application. According to ¶ [0007] of the specification of the above-captioned application, the vibrations associated with a water hammer are substantial enough to cause "breakdown of devices or instruments connected to the [fluid] passage." The definition of "water hammer" listed in Exhibit D and relied upon by the Examiner is broad enough to

opening or closing a pipeline that has water and like fluids flowing through it. The phenomenon is objective because it occurs in the case when shock waves, caused when opening or closing a pipeline, have sufficient velocity that they travel at, or above, the speed of sound of the fluid in the pipeline. Such shock waves traveling at or above the speed of sound in the liquid create a substantially audible "bang," which is akin to a "sonic boom" occurring in the pipes. The "water hammer," just like a sonic boom, is an objective phenomenon.

10. The Lahlou Article describes another form of transient pressure fluctuations that occur when opening or closing a pipeline called "surge." According to the Lahlou Article, page 1, left col., lines 19-28, "surge" is a less severe form of transient pressure, which is due to

> "a slow motion mass oscillation of water caused by internal pressure fluctuations in the system. This can be pictured as a slower 'wave' of pressure building within the system. Both water hammer and surge are referred to as transient pressures. If not controlled, they both yield the same results: damage to pipes, fittings, and valves, causing leaks and shortening the life of the system."

11. Based on my knowledge and experience in the art, and based on the above-passages of the Lahlou Article, I can state that "surge," as that term is known in the art, pertains to transient pressures having a wave velocity of less than the speed of sound in the fluid. Therefore, while "surge" may cause audible noise in a pipe, it does not cause the "bang" associated with a water hammer because there is no sonic boom in the pipes. As discussed above, and as I believe any person of ordinary skill in the art would know, only the water hammer generates a "bang" because it is associated with a sonic boom, so to speak, that occurs when the velocity of the pressure wave is equal to, or exceeds, the speed of sound in the fluid in the pipe. Surge, then, by definition is not associated with "banging" in the pipes

read on transient pressures that do not reasonably cause damage and that are not reasonably construed to be a water hammer, or even surge. As described by Figures 4(a) and 4(b) and ¶¶ [0038] and [0039] of the above-captioned application, the invention eliminates the water hammer, but not necessarily all transient pressures (i.e., such as those that are nearly zero) in the system. Therefore, I conclude that the definition of water hammer from Exhibit D, and relied upon by the Examiner, is not consistent with how the term is defined and used in the specification and claims of the above-captioned application.

20. Exhibit D includes two other definitions of "water hammer" as follows:

> "1. A banging noise heard in a water pipe following an abrupt alternation of the flow with resultant pressure surges."
>
> 2. A banging noise in steam pipes, caused by steam bubbles entering a cold pipe partially filled with water."

Of these two additional definitions of "water hammer" listed in Exhibit D, only the first is roughly consistent with how this term is used by persons skilled in the art because it specifies that a "banging" noise is generated when flow is abruptly altered, such as would be consistent with the sonic-boom type noise caused by transient pressures traveling at the speed of sound or faster in the fluid in the pipe. The second definition relating to steam bubbles is not germane to the subject matter of the above-captioned application.

21. In view of the above facts, I conclude that the Examiner has not given Exhibit D a fair reading as a whole because Exhibit D provides a more appropriate and accurate definition of "water hammer" than the one relied upon by the Examiner. Furthermore, the definition relied upon by the Examiner for "water hammer" is not in accordance with how a person of ordinary skill in the art would define a "water hammer" as evident from the disclosures of

the Omega Document, the Lahlou Article, the Formisano Article, and the LMNOENG Document, and it is not in accordance with how the term is used in the specification and claims of the above-captioned application.

The Water Hammer is an Objective Phenomenon and not a Relative "Term of Degree"

22. Based on my knowledge and experience in the art, and as amply supported by the disclosures of the Omega Document, the Lahlou Article, the Formisano Article, and the LMNOENG Document , I state that the "water hammer," as that term is used in the art in the context of opening or closing a fluid passage, pertains to an objective physical phenomenon that occurs when abruptly opening or closing of a fluid passage causes the formation of transient pressure waves having a velocity that is equal to, or exceeds, the speed of sound in the fluid in the fluid passage. Consequently, the "water hammer" is associated with a banging noise, which pertains to a sonic boom, so to speak, that occurs in the passage due to the high velocity of the transient pressures.

23. To the extent the Examiner contends that the term "water hammer" is a "term of degree" that covers in scope any transient pressure wave that generates a noise in a fluid passage (See, e.g., Office Action, mailed February 12, 2010, at 9, lines 6-22), I state for the record that the Examiner's contention is factually incorrect. As discussed above, the noise associated with the water hammer is a "bang" (i.e., a type of sonic boom) caused by shock waves traveling faster than the speed of sound in the fluid of the passage. A broader definition of the term "water hammer," such as may cover in scope transient pressures that may make a noise but do not have the potential to cause the breakdown of devices or

instruments connected to the passage is not consistent with how the term is generally used by persons of ordinary skill in the art (See, e.g., the Omega Document, the Lahlou Article, the Formisano Article, and the LMNOENG Document), and it is not consistent with how the term is used in the specification and claims of the above-captioned application.

24. I further state for the record that, as an expert in the field, I know the Examiner's conclusion that a "'water hammer' is a term of degree, since these physical effects (noise) will occur to a greater or lesser extent if fluid flow of a greater or lesser extent is suddenly stopped" (Office Action, mailed February 12, 2010, at 9, lines 17-19), is an incorrect conclusion. The Examiner's conclusion is at odds with how the term "water hammer" is generally used by persons skilled in the art (i.e., to refer to hydraulic shock waves traveling at or faster than the speed of sound) and is at odds with how the term "water hammer" is defined and used by the specification and claims of the above-captioned application.

Summary

25. It is my opinion, based on the materials and evidence I have considered, that:

a. the term "water hammer" as defined and used in the specification and claims of the above-captioned application pertains to hydraulic shock caused when abruptly opening or closing a fluid passage, and that this hydraulic shock causes upstream vibrations that are substantial enough to cause the breakdown of devices or instruments connected to the fluid passage, and that the term "water hammer" does not include transient pressures that are nearly zero or that are not sufficient in magnitude to cause the breakdown of devices or instruments connected to the fluid passage;

b. the term "water hammer" as this term is generally used in the art pertains to transient pressures that travel at or faster than the speed of sound in the fluid in the passage and, therefore, cause a banging noise, and also cause the breakdown of devices or instruments connected to the fluid passage;

c. the term "surge" as this term is generally used in the art pertains to transient pressures that travel at less than the speed of sound in the fluid in the passage and, therefore, are not associated with a banging noise, but still have sufficient force to cause the breakdown of devices or instruments connected to the fluid passage; and

d. the term "water hammer" as defined and used in the specification and claims of the above-captioned application covers in scope the "water hammer" as this term is conventionally defined with respect to transient pressures traveling at or above the speed of sound in the fluid in the passage; however, the term "water hammer" as defined and used in the specification and claims could read on "surge" as this term is conventionally known because surge can also cause the breakdown of devices and instruments connected to the passage.

26. I declare under penalty of perjury that the foregoing is true and correct, that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed by,

Date: 12, july, 2010

Signature: Kouji Nishino

Name: Kouji NISHINO

Title: Manager, Fujikin Incorporated

APPENDIX:

1. A multi-step method for abrupt water hammerless opening of a fluid passage, the method comprising the steps of:

(a) providing a fluid passage openable by operation of an actuator operating type valve provided on the fluid passage of a pipe passage, wherein the fluid passage has a nearly constant pressure inside the pipe passage;

(b) detecting a vibration detecting signal Pr from vibration of the pipe passage caused by a change of internal pressure of the pipe passage;

(c) moving a valve body of the actuator operating type valve from a state of full valve closing in a direction of valve opening to a first degree of valve opening by increasing driving input to an actuator of the actuator operating type valve, wherein the driving input is increased to a first prescribed set value sufficient to prevent a water hammer in the fluid passage, wherein the first prescribed set value is a step pressure setting signal Ps wherein the vibration detecting signal Pr does not exceed a permissible upper limit vibration setting signal Prm;

(d) holding the driving input to the actuator at the first set value for a first period of time; and then

(e) further increasing the driving input to move the valve body from the first degree of valve opening to a state of full valve opening so the fluid passage is opened without causing a water hammer, and wherein the valve body of the actuator operating type valve is moved from the state of full valve closing to the state of full valve opening in only two steps, or only three steps, or only four steps.

2. A multi-step method for abrupt water hammerless opening of a fluid passage as claimed in Claim 1, wherein the valve is a normally closed and pneumatic pressure operating type diaphragm valve, wherein the diaphragm valve is a fixed capacity type diaphragm valve wherein an inner capacity of the diaphragm valve is fixed and does not change when the valve is operated.

3. A multi-step method for abrupt water hammerless opening of a fluid passage as claimed in Claim 1, wherein the first period of time is less than 1 second, and a pressure rise value of the fluid passage is made to be within 10% of a first steady state pressure value before opening the valve.

4. (Withdrawn)

5. (Withdrawn)

6. (Withdrawn)

7. (Withdrawn)

8. (Cancelled)

9. (Cancelled)

10. A multi-step method for water hammerless opening of a fluid passage as claimed in Claim 18, wherein the vibration sensor and the tuning box are removeable, and are removed after the control signal data at a time of outputting the second 2-step operating pressure, with which generation of vibration is nearly zero, are inputted to a memory storage of the electro-pneumatic conversion device.

11. A multi-step method for water hammerless opening of a fluid passage as claimed in Claim 18, wherein the vibration sensor is provided at a position on the upstream side within 1000mm from where the actuator operating type valve is installed on the fluid passage.

12. A multi-step method for water hammerless opening of a fluid passage as claimed in Claim 18, wherein a step operating pressure holding time t of the second 2-step operating pressure is set at less than 1 second.

13. (Withdrawn)

14. (Withdrawn)

15. (Cancelled)

16. (Cancelled)

17. (Cancelled)

18. A multi-step method for water hammerless opening of a fluid passage, the method comprising the steps of:

(a) providing a fluid passage openable by operation of an actuator operating type valve provided on the fluid passage of a pipe passage, wherein the fluid passage has a nearly constant pressure inside the pipe passage;

(b) moving a valve body of the actuator operating type valve toward a full valve opening state by increasing driving input to an actuator of the actuator operating type valve, wherein the driving input is increased to a first prescribed set value thereby partially opening the actuator operating type valve;

(c) holding the driving input to the actuator at the first set value for a first period of time; and then

(d) further increasing the driving input to move the valve body to the state of full valve opening so the fluid passage is opened, wherein the fluid passage has a vibration sensor removably fixed on an upstream side of the actuator operating type valve installed on the fluid passage;

(e) inputting a vibration detecting signal Pr from the vibration sensor to a tuning box when opening the fluid passage; and then,

(f) inputting a first control signal from the tuning box to an electro-pneumatic conversion device; and

(g) generating a first 2-step actuator operating pressure in the electro-pneumatic conversion device when the first control signal is inputted, wherein the first 2-step actuator operating pressure includes a first step actuator operating pressure, an initial intermediate step operating pressure, and a second step actuator operating pressure, and a final step operating pressure, and supplying the first 2-step actuator operating pressure to the actuator operably connected to the actuator operating type valve so that the actuator operating type valve is made to open in a 2-step operation, wherein the first 2-step actuator operating pressure to be supplied to the actuator and the vibration detecting signal are compared for a relative relationship of the two, and

i. when vibration is generated at a time when the first step actuator operating pressure rises so the first step actuator operating pressure is equal to the initial intermediate step operating pressure, then the initial intermediate step operating pressure of the first 2-step operating pressure is adjusted so that the initial intermediate step operating pressure is lowered to form a corrected intermediate step

operating pressure that is determined so as to decrease the vibration detecting signal Pr; and

ii. when vibration is generated at a time when the second step actuator operating pressure rises so that the second step actuator operating pressure rises from the initial intermediate step operating pressure to the final step operating pressure, then the initial intermediate step operating pressure of the first 2-step operating pressure is adjusted so that the initial intermediate step operating pressure is raised to form the corrected intermediate step operating pressure that is determined so as to decrease the vibration detecting signal Pr,

wherein a second intermediate step operating pressure is determined by repeating a plurality of preliminary adjustments of raising or lowering corrected intermediate step operating pressure so that the actuator operating type valve is made to open based on second control signal data that corresponds to a second 2-step operating pressure that includes the second intermediate step operating pressure, wherein the second control signal data is then inputted to the electro-pneumatic conversion device to control movement of the valve body without causing a water hammer because generation of vibration in the fluid passage is nearly zero, and the vibration detecting signal Pr is nearly zero.

19. (Cancelled)

20. A multi-step method for abrupt water hammerless opening of a fluid passage as claimed in Claim 1, wherein the fluid passage is opened from the state of full valve closing to the state of full valve opening within 300 to 1000 msec without causing a water hammer.

21. A multi-step method for abrupt water hammerless opening of a fluid passage, the method comprising the steps of:

(a) providing a fluid passage openable by operation of an actuator operating type valve provided on the fluid passage of a pipe passage, wherein the fluid passage has a nearly constant pressure inside the pipe passage;

(b) detecting a vibration detecting signal Pr from vibration of the pipe passage caused by a change of internal pressure of the pipe passage;

(c) moving a valve body of the actuator operating type valve from a state of full valve closing in a direction of valve opening to a first degree of valve opening by decreasing driving input to an actuator of the actuator operating type valve, wherein the driving input is reduced to a first prescribed set value sufficient to prevent a water hammer in the fluid passage, wherein the first prescribed set value is a step pressure setting signal Ps wherein the vibration detecting signal Pr does not exceed a permissible upper limit vibration setting signal Prm;

(d) holding the driving input to the actuator at the first set value for a first period of time; and then

(e) further decreasing the driving input to move the valve body from the first degree of valve opening to a state of full valve opening so the fluid passage is opened without causing a water hammer, and wherein the valve body of the actuator operating type valve is

moved from the state of full valve closing to the state of full valve opening in only two steps, or only three steps, or only four steps.

22. (Withdrawn)

23. A multi-step method for abrupt water hammerless opening of a fluid passage as claimed in Claim 21, wherein the fluid passage is opened from the state of full valve closing to the state of full valve opening within 300 to 1000 msec without causing a water hammer.

24. (Cancelled)

25. A multi-step method for water hammerless opening of a fluid passage, the method comprising the steps of:

(a) providing a fluid passage openable by operation of an actuator operating type valve provided on the fluid passage of a pipe passage, wherein the fluid passage has a nearly constant pressure inside the pipe passage;

(b) moving a valve body of the actuator operating type valve toward a full valve opening state by decreasing driving input to an actuator of the actuator operating type valve, wherein the driving input is decreased to a first prescribed set value thereby partially opening the actuator operating type valve;

(c) holding the driving input to the actuator at the first set value for a first period of time; and then

(d) further decreasing the driving input to move the valve body to a state of full valve opening so the fluid passage is opened, wherein the fluid passage has a vibration sensor

removably fixed on an upstream side of the actuator operating type valve installed on the fluid passage;

(e) inputting a vibration detecting signal Pr to a tuning box when opening the fluid passage; and then,

(f) inputting a first control signal from the tuning box to an electro-pneumatic conversion device; and

(g) generating a first 2-step actuator operating pressure in the electro-pneumatic conversion device when the first control signal is inputted, wherein the first 2-step actuator operating pressure includes a first step actuator operating pressure, an initial intermediate step operating pressure, and a second step actuator operating pressure, and a final step operating pressure, and supplying the first 2-step actuator operating pressure to the actuator operably connected to the actuator operating type valve so that the actuator operating type valve is made to open in a 2-step operation, wherein the first 2-step actuator operating pressure to be supplied to the actuator and the vibration detecting signal Pr are compared for a relative relationship of the two, and

i. when vibration is generated at a time when the first step actuator operating pressure drops so the first step actuator operating pressure is equal to the initial intermediate step operating pressure, then the initial intermediate step operating pressure of the first 2-step operating pressure is adjusted so that the initial intermediate step operating pressure is raised to form a corrected intermediate step operating pressure that is determined so as to decrease the vibration detecting signal Pr; and

ii. when vibration is generated at a time when the second step actuator operating pressure drops so that the second step actuator operating pressure drops

from the initial intermediate step operating pressure to the final step operating pressure, then the initial intermediate step operating pressure of the first 2-step operating pressure is adjusted so that the initial intermediate step operating pressure is lowered to form the corrected intermediate step operating pressure that is determined so as to decrease the vibration detecting signal Pr, wherein a second intermediate step operating pressure is determined by repeating a plurality of preliminary adjustments of raising or lowering corrected intermediate step operating pressure so that the actuator operating type valve is made to open based on second control signal data that corresponds to a second 2-step operating pressure that includes the second intermediate step operating pressure, wherein the second control signal data is then inputted to the electro-pneumatic conversion device to control movement of the valve body without causing a water hammer because generation of vibration in the fluid passage is nearly zero, and the vibration detecting signal Pr is nearly zero.